

Risk factors and implications of anastomotic complications after surgery for Crohn's disease

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Abstract

Anastomotic complications occur more frequently in patients with Crohn's disease leading to postoperative intra-abdominal septic complications (IASC). Patients with IASC often require re-operation or drainage to control

the sepsis and have an increased frequency of disease recurrence. The aim of this article was to examine the factors affecting postoperative IASC in Crohn's disease after anastomoses, since some risk factors remain controversial. Studies investigating IASC in Crohn's operations were included, and all risk factors associated with IASC were evaluated: nutritional status, presence of abdominal sepsis, medication use, Crohn's disease type, duration of disease, prior operations for Crohn's, anastomotic technique, extent of resection, operative timing, operative length, and perioperative bleeding. In this review, the factors associated with an increased risk of IASC are preoperative weight loss, abdominal abscess present at time of surgery, prior operation, and steroid use. To prevent IASC in Crohn's patients, preoperative optimization with nutritional supplementation or drainage of abscess should be performed, or a diverting stoma should be considered for patients with multiple risk factors.

Key words: Crohn's disease; Risk factors; Complications; Resection; Postoperative septic complications; Anastomosis

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Core tip: Intra-abdominal sepsis is a common complication in intestinal anastomoses in Crohn's disease; therefore, identifying the risk factors prior to surgery can improve outcomes. This review identified preoperative weight loss, abdominal abscess present at surgery, prior surgery, and steroid use as risk factors for postoperative anastomotic complications. Outcomes in Crohn's operations with these risk factors may be improved with preoperative nutritional supplementation and drainage of the intra-abdominal abscess. If multiple risk factors are present and preoperative interventions are not feasible, a diverting stoma should be considered.

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INTRODUCTION

Crohn's disease is a chronic inflammatory disease which will eventually lead to surgical intervention in a majority of patients. Medical therapy can prolong the time spent in remission and delay the need for surgery, but the rate of surgical intervention has not subsequently decreased as 70%-90% of patients will require an operation during their lifetime^[1,2]. Although any portion of the bowel may be affected, Crohn's disease is found most commonly in the terminal ileum thus ileocelectomy is the most common operation^[3,4]. Patients with Crohn's have a higher complication rate, especially anastomotic complications leading to intra-abdominal sepsis, than patients without an inflammatory state. Intra-abdominal septic complications (IASC) include anastomotic leak, intra-abdominal abscess, and development of a fistula with in approximately 30 d postoperatively. Multiple observational studies have investigated the risk factors associated with IASC in order to identify patients to optimize preoperatively or include a diverting stoma to decrease the severity of complications, although some risk factors remain controversial. This review will focus on risk factors for IASC in patients undergoing surgery with intestinal anastomoses, mainly with ileocolic anastomoses, with Crohn's disease.

A Medline search was performed using keywords Crohn's disease, complications, anastomosis, post-operative sepsis, and surgery. From the articles reviewed, additional articles from the references were also included. Articles after 1980 were considered. A total of 27 articles were finally used.

RISK FACTORS FOR ANASTOMOTIC COMPLICATIONS IN CROHN'S DISEASE

Nutritional status

The preoperative nutritional status of patients in most studies was assessed by at least one of three parameters: preoperative serum albumin level, weight loss, and body-mass index (BMI). There is no gold standard for nutritional assessment in inflammatory bowel disease (IBD). BMI and unintentional weight loss are agreed upon measures for nutrition in Crohn's patients^[5,6]. Albumin is associated with nutritional status in IBD; however, during an acute phase response, such as active Crohn's disease, albumin levels can fall^[5]. Thus low albumin could be indicative of the disease state rather than nutritional status alone.

Serum albumin was the most commonly assessed nutritional parameter in studies included in this review. One study found albumin less than 3.0 mg/dL to be

associated with an increased risk of IASC in a multivariate analysis^[7], while another study found association in a univariate but not multivariate analysis^[8]. Other studies using the same cutoff value, albumin < 3.0 mg/dL, did not find a similar association^[9-11]. These results are further complicated by a study including preoperative nutritional supplementation in patients with an albumin less than 3.0 mg/dL^[9]. Moreover, albumin level less than 3.5 mg/dL^[12,13] and less than 4.0 mg/dL^[14] were reported to have no association with IASC. One study that did not find albumin to be associated with IASC did not define albumin parameters^[15]. A recent meta-analysis using many of these described studies found a correlation with low albumin and increased risk of IASC^[16], but the definition of low albumin is quite inconsistent in these studies making even the pooled results difficult to determine.

Unexpected weight loss described as loss of 5%-10% body weight from the pre-morbid condition provides inconsistent data. Weight loss is associated with increased IASC in some studies^[17,18]. Another study did not identify weight loss as a risk factor for IASC, although the definition for weight loss included patients requiring the need for preoperative nutrition^[15]. Including patients receiving preoperative nutrition may confound the results by improving nutritional status at the time of surgery. Serradori *et al*^[19] also found that weight loss before surgery did not impact IASC rate and included patients receiving preoperative nutritional support, although without specification of parenteral or enteral nutrition. In addition, no patients receiving preoperative nutrition developed an IASC. This data could suggest that patients who have weight loss preoperatively may benefit from nutritional supplementation prior to surgery to ameliorate the risk of complications.

Multiple studies reported BMI, although no study found BMI to be a risk factor for ISAC^[8,14,17,18]. Despite the lack of association between BMI and abdominal septic complications, it should be noted that in these studies there were multiple variations in reporting BMI, such as, mean BMI^[17,19], BMI less than 18.5^[8], less than 20^[18], or BMI less than 25^[14]. Although BMI may be a reliable measure of malnutrition in preoperative Crohn's patients, BMI is not a risk factor for post-operative abdominal sepsis.

Abdominal sepsis

Intra-abdominal sepsis includes intra-abdominal abscess and/or fistula present at the time of surgery. Studies that investigated the presence of intra-abdominal abscess at the time of surgery for Crohn's disease found these patients at an increased risk of IASC^[7,15,17,20]. In contrast, abscess was not associated with abdominal complications in other studies^[13,14]. The studies that combined presence of preoperative abscess and fistula were inconsistent. Some studies found no effect on the rate of IASC with abscess and fistula^[9-11] while other studies reported an association in univariate

analysis^[8,21], and one found association also in a logistic regression analysis^[8]. Some studies included abscesses that were drained preoperatively and found no association with abscess and postoperative IASC^[14,18]. In contrast, studies which excluded preoperatively drained abscesses from the analysis, abscess present at time of surgery increased the risk of IASC with an odds ratio (OR = 3.4, 95%CI: 1.2-9.8)^[15] and (OR = 7.5, 95%CI: 1.5-37.69)^[17]. A meta-analysis which included most studies discussed regarding intra-abdominal abscess, including studies which combined abscess and fistula or included drained abscesses, found an increased risk of IASC with intra-abdominal abscess. Thus, the risk of IASC is higher when an intra-abdominal abscess is present, but the risk is likely ameliorated if the abscess is drained preoperatively.

The presence of an intra-abdominal fistula at the time of surgery has conflicting results as well. Multiple studies found no correlation between presence of fistula and IASC^[13-15,18]. One study found fistula to be an independent risk factor for IASC^[7], and in addition, one study found an association of fistula and IASC in a univariate analysis but not in a multivariate analysis^[17]. These observational studies are the best data currently, as a meta-analysis of fistula alone has not been performed. There is no clear consensus that fistula alone at the time of surgery increases the IASC rate.

Medications

Most patients undergoing surgery for Crohn's disease are on medical therapy, either a single medication or a combination of medications including immunosuppressive medications, biologics, and steroids. Many studies have investigated these medications, and a majority of those studies report overall complications or just septic complications without specifying intra-abdominal sepsis. This review will only discuss those publications reporting IASC.

The use of corticosteroids in managing Crohn's disease has decreased with the advent of immunomodulators and biologics, but corticosteroid use in the perioperative period is still prevalent. Many studies investigated the postoperative complications with perioperative steroid use. Studies prior to 2010 only include corticosteroids in the analyses^[7,9,12,13,17,18], while the more recent studies also include other medications^[8,10,11,14,19,21,22]. The inclusion criteria for steroids widely varies between studies, as some studies do not define steroid use^[9,11,13,18,19,22,23] while others require at least 4 wk^[7,8,14,15,21] or 3 mo of steroid use prior to surgery^[10,17]. Multiple studies found preoperative steroid use to be an independent risk factor in multivariate analysis^[7,9,15,17]. Other studies found that steroid use increased IASC in a univariate analysis but not with a multivariate analysis^[10,19]. In contrast, one study found steroid use to be protective of IASC^[21], while other studies did not find an association between steroid use and postoperative abdominal sepsis^[8,10,11,13,14,18,22]. In a meta-analysis including many of the studies presented here, steroid

use was identified as a risk factor for IASC^[16]. Thus perioperative steroid use should be considered an independent risk factor for IASC.

Immunosuppressants investigated were most commonly azathioprine, but some studies also included 6-mercaptopurine and methotrexate. Since these medications are not widely used, there are fewer studies reporting the postoperative outcome in conjunction with immunosuppressants. Only two studies reported a length of use criteria for inclusion, greater than 3 mo^[8,21], while other studies did not define the inclusion criteria for length of preoperative steroid use. Immunomodulators were an independent risk factor for IASC in two studies^[8,11]. Other studies^[10,14,19,21,22] did not find an association with IASC and immunosuppressants, nor did a meta-analysis^[16]. Immunosuppressants do not definitively affect postoperative outcomes.

Anti-tumor necrosis factor alpha (anti-TNF- α) drugs, or biologics, are increasingly used in Crohn's disease especially since a "top-down" approach for severe Crohn's disease is becoming more common to facilitate remission and delay surgery. A meta-analysis in 2014 suggested increased infectious complications with the use of anti-TNF agents, but all types of infectious complication not only intra-abdominal septic complications were included^[24]. Individual studies investigating only IASC with biologics did not have similar findings. These studies included patients with biologic use within 8-12 wk before surgery^[19,21,25], and one study also included anti-TNF use up to 4 wk postoperatively^[22]. Some studies found biologics to be independent risk factors for IASC^[19,22] while others did not find an association^[10,21,22]. Moreover, a meta-analysis found no clinical implication of IASC risk with biologic use^[16]. Anti-TNF agents do not increase the risk of postoperative intra-abdominal sepsis, although the association with overall postoperative complications is beyond the scope of this review.

Disease characteristics

Crohn's disease can behave as penetrating, stricturing, or nonstricturing/nonpenetrating, in order from least to most common presentation^[4]. Most studies do not differentiate disease type, but Kanazawa *et al.*^[14] found penetrating disease to have an increased risk of IASC. Other studies did not find that disease classification impacted the IASC rate^[9,10,22]. Patients with obstructing disease can have progression to perforating behavior, so in studies that included recurrent resections it is unclear if the disease type was readdressed for patients undergoing subsequent operations. Due to the limited number of studies investigating disease type, the presence of an abscess likely is a more important risk factor for postoperative complications than the disease type.

Duration of disease and prior operations

The duration of disease prior to an operation is shown to correlate with IASC, but only one study found an

association with disease greater than 10 years and risk of IASC^[10]. Another study further classified disease severity into less than 1 year, 1-10 years and greater than 10 years without finding the same correlation^[7]. The average duration of disease was found to be associated with IASC in univariate but not multivariate analysis in some studies^[17,21], while other studies found no association^[9,12]. Moreover, a prior resection or operation for Crohn's disease was not correlated with the risk of postoperative IASC^[7-10,14,15]. Regardless of these studies finding no influence of prior operation on IASC, a meta-analysis showed an increased risk with an OR of 1.5^[16]. The duration of disease does not appear to be a clinical factor associated with IASC, but prior operation appears to be a risk factor for IASC from the meta-analysis results despite lack of significant finding in each study.

Anastomosis technique

The type of anastomosis, stapled side-to-side and hand-sewn end-to-end anastomoses, have been thoroughly investigated. Some studies found an increased risk of IASC with hand-sewn anastomoses compared to stapled anastomoses^[13,14]. Multiple other studies found no difference in postoperative IASC between stapled and hand-sewn anastomoses^[7,8,10,21]. Alves *et al.*^[17] found no difference with only hand-sewn side-to-side and hand-sewn end-to-end configuration of anastomoses. A meta-analysis did not find an association with the method of anastomotic configuration^[16], therefore, there is no increased risk of IASC with either stapled or hand-sewn anastomosis. Although a majority of studies included only ileocolic resections or ileal stricturoplasties, three of these studies included colocolonic anastomoses and found an independent increase risk for IASC with these anastomoses^[8,10,21], but other studies found no association of large vs small bowel involvement at the time of operation, although the site of anastomosis was not specified^[7,9]. Thus the method of creating an anastomosis does not affect early postoperative complications in ileocolic anastomoses; however, there is not enough data to support the same conclusion for colonic anastomoses.

Extent of resection and margins

The extent of resection was only investigated in one study, in which IASC was not associated with extent of resection^[12]. The number of anastomoses was reported in multiple studies to have no association with postoperative intra-abdominal sepsis^[8,9,14,21]; furthermore, multiple resections were associated with increased IASC in a univariate but was not associated in a multivariate analysis^[18]. The presence of macroscopic disease in the margin was investigated in a randomized controlled trial by Fazio *et al.*^[26], which reported that recurrence rate is not affected by either the width of macroscopic margin or presence of microscopic Crohn's disease at the margins. Conflicting results were found in two studies which investigated the impact of microscopically positive

margins on IASC. One study found histologically positive margins to be an independent risk factor for IASC^[10], while another study found no increased risk of IASC with inflammation present at the margins^[9]. Although no meta-analysis has been performed on these data, the majority of studies suggest that multiple resections and extent of resection are not associated with increased intra-abdominal sepsis.

Operative timing

Crohn's disease can require urgent or elective surgeries depending on the indication for surgery. Only one study found an association between emergent operation and increased risk for IASC although it was not an independent risk factor in a multivariate analysis^[10]. In contrast, emergent surgery was not associated with IASC in other studies^[14,17]. Thus the setting of emergent compared to elective operation does not greatly impact postoperative intra-abdominal complications.

Operative time

The length of time in the operating room has previously been identified as a risk factor for anastomotic leak in colorectal surgery^[27]. The operative time was independently associated with IASC in two studies^[14,21], however it was not associated with IASC in another study^[17]. Like other colorectal surgeries, prolonged operations could increase the risk of IASC especially anastomotic leak, but larger studies or a meta-analysis would provide more definitive recommendations.

Perioperative bleeding

Blood loss in the operating room greater than 150 mL is an independent risk factor for IASC^[21], and blood loss greater than 300 mL was associated with an increased risk of IASC in univariate but not multivariate analysis^[14]. Some studies reported perioperative blood transfusion, suggesting increased blood loss; however, blood loss or transfusion does not clinically impact IASC^[8,17].

Smoking

Cigarette smoking can affect the disease course as those who smoke have an increased need for surgery as well as increased risk of recurrence^[20]. Smoking has been associated with an increased risk in overall complication rates after surgery for Crohn's disease^[23], but intra-abdominal sepsis was not association with an increased rate of postoperative abdominal septic complications. Smoking did not affect the rate of IASC^[10,11,15,17] thus smoking is not a risk factor for IASC.

DISCUSSION

Preoperative nutritional status in Crohn's patients, measured by unexpected weight loss, increased the risk for postoperative IASC. When patients with weight loss receive preoperative nutritional supplementation,

this effect is no longer seen. Albumin level also seems to be associated with higher IASC rate in meta-analyses, but the albumin ranges varied widely between studies, complicating the combined data interpretation for albumin. Preoperative malnutrition nonetheless is associated with increased IASC. Intra-abdominal sepsis, with presence of an abscess at time of surgery, increased the risk for IASC, and some studies showed preoperative drainage decreased this risk. Steroid use before surgery was associated with an increase in IASC. Prior operation was a risk factor in a meta-analysis, but each study included in that analysis did not find an association with IASC. Further investigations, such as a larger study, are needed to verify the increased IASC risk with prior operation for Crohn's disease. Although prolonged operative time was the final variable associated with a higher rate of IASC, this was based upon limited number of studies thus further investigation is warranted. Factors not associated with IASC are use of immunomodulators or biologics, duration of disease, operative setting: emergent or elective, blood loss, and smoking. Since IASC is associated with an increased risk of early recurrence, preventing IASC can assist in lowering the recurrence rate and subsequently the need for further surgery.

CONCLUSION

Risk factors associated with postoperative anastomotic complications in Crohn's disease include preoperative weight loss, abdominal abscess present at surgery, prior surgery, and steroid use. Preoperative optimization should be attempted to decrease postoperative complications in these patients, particularly nutritional supplementation and abscess drainage. Since IASC is associated with an increased risk of early recurrence, preventing IASC can assist in lowering the recurrence rate and subsequently the need for further surgery. In patients with multiple risk factors that cannot be optimized preoperatively, a diverting stoma should be considered.

REFERENCES

- 1 **Farmer RG**, Whelan G, Fazio VW. Long-term follow-up of patients with Crohn's disease. Relationship between the clinical pattern and prognosis. *Gastroenterology* 1985; **88**: 1818-1825 [PMID: 3922845]
- 2 **Cosnes J**, Nion-Larmurier I, Beaugerie L, Afchain P, Tiret E, Gendre JP. Impact of the increasing use of immunosuppressants in Crohn's disease on the need for intestinal surgery. *Gut* 2005; **54**: 237-241 [PMID: 15647188 DOI: 10.1136/gut.2004.045294]
- 3 **Michelassi F**, Balestracci T, Chappell R, Block GE. Primary and recurrent Crohn's disease. Experience with 1379 patients. *Ann Surg* 1991; **214**: 230-238; discussion 238-240 [PMID: 1929605]
- 4 **Langholz E**. Current trends in inflammatory bowel disease: the natural history. *Therap Adv Gastroenterol* 2010; **3**: 77-86 [PMID: 21180592 DOI: 10.1177/1756283X10361304]
- 5 **Mijac DD**, Janković GL, Jorga J, Krstić MN. Nutritional status in patients with active inflammatory bowel disease: prevalence of malnutrition and methods for routine nutritional assessment. *Eur J Intern Med* 2010; **21**: 315-319 [PMID: 20603043 DOI: 10.1016/j.ejim.2010.04.012]
- 6 **Valentini L**, Schulzke JD. Mundane, yet challenging: the assessment of malnutrition in inflammatory bowel disease. *Eur J Intern Med* 2011; **22**: 13-15 [PMID: 21238886 DOI: 10.1016/j.ejim.2010.07.021]
- 7 **Yamamoto T**, Allan RN, Keighley MR. Risk factors for intra-abdominal sepsis after surgery in Crohn's disease. *Dis Colon Rectum* 2000; **43**: 1141-1145 [PMID: 10950014]
- 8 **Myrelid P**, Olaison G, Sjö Dahl R, Nyström PO, Almer S, Andersson P. Thiopurine therapy is associated with postoperative intra-abdominal septic complications in abdominal surgery for Crohn's disease. *Dis Colon Rectum* 2009; **52**: 1387-1394 [PMID: 19617749 DOI: 10.1007/DCR.0b013e3181a7ba96]
- 9 **Post S**, Betzler M, von Ditfurth B, Schürmann G, Küppers P, Herfarth C. Risks of intestinal anastomoses in Crohn's disease. *Ann Surg* 1991; **213**: 37-42 [PMID: 1985536]
- 10 **Shental O**, Tulchinsky H, Greenberg R, Klausner JM, Avital S. Positive histological inflammatory margins are associated with increased risk for intra-abdominal septic complications in patients undergoing ileocolic resection for Crohn's disease. *Dis Colon Rectum* 2012; **55**: 1125-1130 [PMID: 23044672 DOI: 10.1097/DCR.0b013e318267c74c]
- 11 **Tay GS**, Binion DG, Eastwood D, Otterson MF. Multivariate analysis suggests improved perioperative outcome in Crohn's disease patients receiving immunomodulator therapy after segmental resection and/or stricturoplasty. *Surgery* 2003; **134**: 565-572; discussion 572-573 [PMID: 14605616 DOI: 10.1016/S0039]
- 12 **Heimann TM**, Greenstein AJ, Mechanic L, Aufses AH. Early complications following surgical treatment for Crohn's disease. *Ann Surg* 1985; **201**: 494-498 [PMID: 3977451]
- 13 **Resegotti A**, Astegiano M, Farina EC, Ciccone G, Avagnina G, Giustetto A, Campa D, Fronda GR. Side-to-side stapled anastomosis strongly reduces anastomotic leak rates in Crohn's disease surgery. *Dis Colon Rectum* 2005; **48**: 464-468 [PMID: 15719193 DOI: 10.1007/s10350-004-0786-6]
- 14 **Kanazawa A**, Yamana T, Okamoto K, Sahara R. Risk factors for postoperative intra-abdominal septic complications after bowel resection in patients with Crohn's disease. *Dis Colon Rectum* 2012; **55**: 957-962 [PMID: 22874602 DOI: 10.1097/DCR.0b013e3182617716]
- 15 **Tzivanakis A**, Singh JC, Guy RJ, Travis SP, Mortensen NJ, George BD. Influence of risk factors on the safety of ileocolic anastomosis in Crohn's disease surgery. *Dis Colon Rectum* 2012; **55**: 558-562 [PMID: 22513434 DOI: 10.1097/DCR.0b013e318247c433]
- 16 **Huang W**, Tang Y, Nong L, Sun Y. Risk factors for postoperative intra-abdominal septic complications after surgery in Crohn's disease: A meta-analysis of observational studies. *J Crohns Colitis* 2015; **9**: 293-301 [PMID: 25572276 DOI: 10.1093/ecco-jcc/jju028]
- 17 **Alves A**, Panis Y, Bouhnik Y, Pocard M, Vicaut E, Valleur P. Risk factors for intra-abdominal septic complications after a first ileocecal resection for Crohn's disease: a multivariate analysis in 161 consecutive patients. *Dis Colon Rectum* 2007; **50**: 331-336 [PMID: 17252288 DOI: 10.1007/s10350-006-0782-0]
- 18 **Iesalnieks I**, Kilger A, Glass H, Müller-Wille R, Klebl F, Ott C, Strauch U, Piso P, Schlitt HJ, Agha A. Intraabdominal septic complications following bowel resection for Crohn's disease: detrimental influence on long-term outcome. *Int J Colorectal Dis* 2008; **23**: 1167-1174 [PMID: 18690466 DOI: 10.1007/s00384-008-0534-9]
- 19 **Serradori T**, Germain A, Scherrer ML, Ayav C, Perez M, Romain B, Palot JP, Rohr S, Peyrin-Biroulet L, Bresler L. The effect of immune therapy on surgical site infection following Crohn's Disease resection. *Br J Surg* 2013; **100**: 1089-1093 [PMID: 23649458 DOI: 10.1002/bjs.9152]
- 20 **Yamamoto T**. Factors affecting recurrence after surgery for Crohn's disease. *World J Gastroenterol* 2005; **11**: 3971-3979 [PMID: 15996018]
- 21 **El-Hussuna A**, Andersen J, Bisgaard T, Jess P, Henriksen M, Oehlenschläger J, Thorlacius-Ussing O, Olaison G. Biologic treatment or immunomodulation is not associated with postoperative anastomotic complications in abdominal surgery for Crohn's disease.

- Scand J Gastroenterol* 2012; **47**: 662-668 [PMID: 22486168 DOI: 10.3109/00365521.2012.660540]
- 22 **Nasir BS**, Dozois EJ, Cima RR, Pemberton JH, Wolff BG, Sandborn WJ, Loftus EV, Larson DW. Perioperative anti-tumor necrosis factor therapy does not increase the rate of early postoperative complications in Crohn's disease. *J Gastrointest Surg* 2010; **14**: 1859-1865; discussion 1865-1866 [PMID: 20872084 DOI: 10.1007/s11605-010-1341-5]
- 23 **Riss S**, Bittermann C, Zandl S, Kristo I, Stift A, Papay P, Vogelsang H, Mittlböck M, Herbst F. Short-term complications of wide-lumen stapled anastomosis after ileocolic resection for Crohn's disease: who is at risk? *Colorectal Dis* 2010; **12**: e298-e303 [PMID: 20041915 DOI: 10.1111/j.1463-1318.2009.02180.x]
- 24 **Ahmed Ali U**, Martin ST, Rao AD, Kiran RP. Impact of preoperative immunosuppressive agents on postoperative outcomes in Crohn's disease. *Dis Colon Rectum* 2014; **57**: 663-674 [PMID: 24819109 DOI: 10.1097/DCR.0000000000000099]
- 25 **Appau KA**, Fazio VW, Shen B, Church JM, Lashner B, Remzi F, Brzezinski A, Strong SA, Hammel J, Kiran RP. Use of infliximab within 3 months of ileocolonic resection is associated with adverse postoperative outcomes in Crohn's patients. *J Gastrointest Surg* 2008; **12**: 1738-1744 [PMID: 18709420 DOI: 10.1007/s11605-008-0646-0]
- 26 **Fazio VW**, Marchetti F, Church M, Goldblum JR, Lavery C, Hull TL, Milsom JW, Strong SA, Oakley JR, Secic M. Effect of resection margins on the recurrence of Crohn's disease in the small bowel. A randomized controlled trial. *Ann Surg* 1996; **224**: 563-571; discussion 571-573 [PMID: 8857860]
- 27 **Buchs NC**, Gervaz P, Secic M, Bucher P, Mugnier-Konrad B, Morel P. Incidence, consequences, and risk factors for anastomotic dehiscence after colorectal surgery: a prospective monocentric study. *Int J Colorectal Dis* 2008; **23**: 265-270 [PMID: 18034250 DOI: 10.1007/s00384-007-0399-3]

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